

PRETEST
SOME MATHEMATICS NECESSARY FOR DOING
SCIENCE

(H. Weller, SMS 491/EDW 472, Spring 2008)

WHAT IS MATHEMATICS? (Circle all that are correct)

- A language like Spanish or French.
- A language plus reasoning.
- A language plus logic.
- A tool for reasoning.
- Necessary for explaining deeply the beauties of Nature.

CONSTANTS OF NATURE (Fill in the blanks)

A speed limit: The ultimate speed in the Universe, $3.00(10^8)$ m/s is called the _____.

An attractive constant: The constant of proportionality, K , between two masses, m_1 and m_2 , and their mutual attractive force, F , in $F=K(m_1m_2/r^2)$ is presumably universal. It is called the _____. (You're right, it's usually not called "K").

Charge it! The basic charge, $1.60(10^{-19})$ coul is apparently universal. It is called the charge of a/an _____.

A quantum change in energy: The smallest amount, h , by which energy can be changed in the Universe is $6.63(10^{-34})$ joule.sec. It is called _____ after a famous physicist who lived 1858-1947.

Matching a gas molecule's kinetic energy to temperature: This constant, $k=1.38(10^{-23})$ joule/ $^{\circ}$ K, which converts units of molecular kinetic energy to units of temperature, is called _____ after a physicist who lived 1844-1906.

**THE GREAT GENERAL PRINCIPLES THAT ALL LAWS SEEM TO FOLLOW
(Fill in the blanks)**

Conservation Law Involving Mass and Velocity

Take all the masses of an object, multiply them by their velocities, and add them together. This total quantity is conserved.

The sum is the _____ of the particles.

The “Coul-est” Conservation Law

There is a number, the total _____ in the world (measured by coulombs), which, no matter what happens, does not change. It was discovered by Michael Faraday (1791-1867).

If you lose it in one place, you will find it in another.

Conservation of the Area Generated Per Second by Objects that Move

For a moving object, if we establish a center anywhere and draw a line from the center to the object, then the speed at which the area swept out by a line from the center to the object, multiplied by the mass of the object, and added together for all objects, is called the _____.

This total quantity does not change. (Yes, figure skaters and divers use this well.)

Conservation of “Joules, ” a Valuable Law

There is a constant interplay between the potential _____ and the kinetic _____ in a system. The total amount of _____ in the system is always the same.

The total amount of this quantity is measured in joules.

This is the most difficult and abstract of all conservation laws.

REFERENCES

Barrow, J. D. (2002). The Constants of Nature. New York: Vintage Books.

Feynman, R. (1965). The Character of Physical Law. Cambridge, MA: The M.I.T. Press.